In 1896, Moissan and Dewar, working in collaboration, effected the liquefaction of fluorine by passing it through a tube cooled in liquid air which was allowed to boil freely. The B.P. of liquid fluorine is about - 187°. The liquid does not solidify even at - 210°. Its density is 1·14; it exhibits no absorption spectrum, and is not magnetic. It is soluble in all proportions in liquid air and oxygen. Liquid fluorine has no chemical action on liquid oxygen, solid mercury, or ice; but even at - 210° it combines with hydrogen, and decomposes benzene with violence, and production of light and heat. It would be interesting to know the order in which the elements cease to react with fluorine as the temperature falls.

We must also refer to the hexafluoride of sulphur prepared by Moissan and Lebeau in April of 1900. It is obtained by the action of excess of fluorine on sulphur; it is one of the heaviest gases known, having a density of 5·03. Its composition, which is represented by the formula SF_6, completely establishes the hexatomic nature of the sulphur atom. It is of interest also on account of its inertness; it is unattacked by fused sodium or potassium. Resulting as it does from the union of two such active elements as sulphur and fluorine, which in combining seem thus to saturate one another completely, this compound may be regarded as additional evidence in favour of the theory of valency, though a chemical Ishmael might view it in a different light.

While engaged in studying the compounds of fluorine, Moissan's interest was aroused in the element boron; he obtained the amorphous variety in quantity, and caused it to unite with iodine, sulphur and phosphorus; he examined the action of alkali metals on boric acid, and, as we shall see later, in speaking of the electric furnace, prepared the carbide BC.

In 1891 the coveted honour of a seat in the Académie des Sciences was conferred upon him in recognition of his brilliant work. Cahours had died. To fill his place the names of Moissan, Grimaux, Ditte, Jungfleisch and Le Bel were submitted to the Comité. After a discussion lasting nearly two hours it was decided to nominate Moissan and Grimaux for election. The latter was defeated by eleven votes, and Moissan became the *confrère* of Berthelot, Friedel, Schützenberger and Troost.

The difficulty which was now hampering his work was one of temperature; he required a source of heat greater than that obtainable from the oxyhydrogen flame, and had recourse to the electric arc. In 1892 he devised the electric furnace, by means of which in its more perfect form a temperature of 3500° C. could be readily attained. The first result was the production of uranium from its oxide in fair quantities. Metals hitherto considered refractory yielded at once to the intense heat, and the electric furnace became in his hands the source of good specimens of chromium, tungsten, titanium, molybdenum, vanadium, zirconium, &c., all obtained from their oxides by reduction with charcoal.

In the following year, 1893, came the production of artificial diamonds, and Moissan's name became the prey of newspaper men and popular lecturers; chemistry began to appeal to the man in the street.

Moissan now took up the compounds of carbon with the metals, and obtained a whole series, comprising the carbides of sodium, potassium, calcium, strontium, barium, yttrium, lanthanum, thorium, aluminium, titanium, zirconium, chromium, uranium and manganese, and of the metalloids, boron and silicon. Quite recently he has added the carbides of neo- and praseo-dymium to the list. Proceeding in the same way with silicon and boron, he prepared the silicides of iron, chromium, tungsten, titanium, molybdenum, &c., and the borides of iron, nickel, cobalt, titanium, molybdenum, calcium, strontium and barium.

In 1898 he succeeded in his efforts to make calcium assume the crystalline form by dissolving it in sodium at a dull red heat, and dissolving away the sodium by absolute alcohol; from this crystalline variety he was able to pass to the hydride, nitride and phosphide of the element. By the electrolysis of fused calcium iodide he was the first to obtain the metal calcium in a state of purity.

When this series of experiments is completed, we shall be in a position to generalise from his results. Not the least interesting feature of the work is the bearing it will have on the Periodic classification; in this connection it should be of supreme importance.

But for the present we must be content with this necessarily brief *résumé* of the scientific work of Henri Moissan. As an experimenter he is unrivalled. "J'avais commencé à manipuler," he says, "de l'âge de 14 à 15 ans; et mes premières leçons de chimie, données par mon père, sont encore gravées dans ma mémoire." He is no theorist in the ordinary sense of the word. His work has been confined to the sphere of the purely practical; and for him a theory exists only that it may be submitted to the test of rigorous experiment, and for the sake of what it leads to. We can conceive of him working out a theory for the origin of diamonds; we find it difficult to conceive of him formulating a theory for the origin of man.

Unlike his distinguished compatriots, M. Berthelot and the late C. Friedel, who worked in both fields, organic and inorganic, Henri Moissan has remained true to the enthusiasm inspired by his first great teacher, Deville. "Je me suis appliqué à cultiver cette chimie minérale que l'on croyait épuisée, et je pense que mes travaux, ainsi que les belles recherches des savants anglais, ont pu démontrer que cette science réserve encore bien des dècouvertes à ceux qui voudront l'aimer et l'étudier avec tenacité." "To love it and pursue it with zeal" is the secret of Moissan's success, as it was of that of Davy and Faraday and Lavoisier.

In the midst of the gayest capital of Europe, but untouched by all the vicissitudes of its political life, he lives and works. "Ma vie a eu toute la simplicité de ma carrière de professeur, et mon existence s'est partagée, heureuse jusqu'ici, entre mon laboratoire et ma maison."

We can only wish him a continuance of this happiness, and in his new sphere an equal measure of success. The Science Faculty of the University of Paris is to be congratulated on the acquisition of so eloquent and so distinguished a teacher.

NOTES.

THE Geological Society of London will this year award its medals and funds as follows:—The Wollaston medal to M. Friedrich Schmidt of St. Petersburg, the Murchison medal to Mr. F. W. Harmer, and the Lyell medals to Mr. R. Lydekker and Prof. Anton Fritsch, of Prague; the Wollaston fund to Mr. L. J. Spencer, the Murchison fund to Mr. T. H. Holland, the Lyell fund to Dr. Wheelton Hind, and the Barlow-Jameson fund to Mr. W. M. Hutchings.

PROF. J. H. MARSHALL, who for three years past has been associated with Mr. Bosanquet in archæological researches at Athens, has been appointed Director-General of the Archæological Survey of India, for a period of five years in the first instance.

THE objects found during the recent excavations at Stonehenge will be on view in the library of the Anthropological Institute, Hanover Square, until January 21.

A MEDALLION bust of Sir George Airy is to be placed in the north-east wall of St. Alphage Parish Church, Greenwich, by his daughters. The bust has been copied from the one in the Royal Observatory, Greenwich.

WE regret to see the announcement that Mr. Clarence King, the eminent geologist, died at Phœnix, Arizona, on December 24, 1901. Mr. King was born in Newport, R.I., and graduated from the Sheffield Scientific School of Yale University in 1852. He was instrumental in the organisation of the U.S. Geological Survey, of which he was director from 1878 to 1881.

WE learn from the *Victorian Naturalist* that the monument erected over the grave, in the St. Kilda Cemetery, of the late Baron Sir F. von Mueller, K.C.M.G., for nearly forty-five years Government Botanist of Victoria, was unveiled on November 26, 1901, by His Excellency the Govenor-General, Lord Hopetoun, in the presence of a large gathering of public and scientific men and personal friends. The monument is in the form of a tall column of polished stone, surmounted by an urn, and resting on a broad pedestal. A medallion in copper of the profile of the late Baron is let into the stone above the inscription.

IT is reported from Paris that M. Ducretet is engaged in carrying out experiments on wireless telephony from which he has already obtained results which he considers are very promising. M. Ducretet's name has been associated with that of M. Popoff in connection with some very successful work in the development of wireless telegraphy. His present experiments do not seem to have gone beyond the laboratory stage, the distance over which speaking has been conducted being only thirty yards. The telephone currents pass through the ground, and it is said that M. Ducretet is about to investigate the conduction through different soils. We hope that he will meet with success, though we are inclined to doubt the practical utility of such a telephonic system, as it is difficult to see in what way, except as a scientific curiosity, it is likely to be superior to present methods.

IT is announced in *Science* that Dr. Ales Hrdlicka is about to start on his fourth expedition among the Indians of the south-western United States and northern Mexico. These expeditions are a part of the system of anthropological exploration and investigation known as the Hyde Expedition, and are carried on under the direction of Prof. F. W. Putnam for the American Museum of Natural History. The expenses of the present undertaking are generously provided for by Mr. F. E. Hyde, jun., of New York City. Dr. Hrdlicka is in charge of the somatological work of the Hyde Expedition, and his plan, now more than half fulfilled, is, in the main, to ascertain the physical characteristics of the extinct as well as the living peoples in that area which has once been occupied by the Cliff-Dwellers and Pueblos, and by the Toltec, Aztec and Chechemec peoples. It is hoped that on the present journey the somatological part of the research in the field will be completed.

DR. J. EVERETT DUTTON, of the Liverpool Malaria Expedition to the Gambia River, gives in a short report a few details of a peculiar case of fever in which he found a parasite resembling that of "tsetse fly disease" of cattle. The case was that of a European, who presented peculiar symptoms, namely: "Irregular attacks of fever lasting over a few days, the temperature not exceeding 101°. The attacks occurred irregularly for a period of some months; abnormal frequent pulse; an increased frequency of respiration, especially on exertion, were noticed. Besides general weakness there was a peculiar œdema of the eyelids and a puffiness about the face, as well as œdema of the legs. The spleen was enlarged, but there were no organic lesions of the heart or kidney, and the urine was normal. An examination of the blood revealed, in somewhat scanty numbers, a parasite, which actively travelled across the field of the microscope backwards or forwards, butting against the red corpuscles, and which was roughly determined to measure 20μ long and 3μ broad. The anterior end tapered off into a long cilium; the lateral membrane was distinct. A drop of blood under a cover glass contained some four to fifteen organisms." The organism is certainly a Trypanosome, but whether *Trypanosoma lewisi* or *T. brucei* or a new species is not yet certain. A single stained blood specimen accompanying the report shows an organism having a long anterior cilium and a rather blunt posterior end. The case was seen and the blood examined several times at the Royal Southern Hospital in September last, but no parasite of any sort could then be demonstrated in the blood. The fever on that occasion was also peculiar.

SOME observations on the seiches of the lake of Lucerne, by M. Ed. Sarasin, of Geneva, are described in the recently issued *Comptes rendus de la Société helvétique*, containing the proceedings for 1899. These observations, which were made at Lucerne, Fluelen and near Vitznau, showed that the period of the uninodal oscillation was 44 minutes, and of the binodal 24 minutes.

A CIVIL SERVICE examination in statistics was held for the first time in June, 1901, in connection with an open competition for the situation of assistant to the head of the statistical branch of the Board of Agriculture. It has been, therefore, considered of interest to reprint the papers both in this subject and in political economy in the *Journal* of the Royal Statistical Society for 1901.

THE preliminary report as to the population of England and Wales in 1901 is discussed by Mr. Thomas A. Welton, in the *Journal* of the Royal Statistical Society for December 31. In the ten years 1891–1901 the increase has been about 12·15 per cent. The large towns have more than held their own, and the new places noted in 1891 have maintained an average high rate of increase. This has been shared by many places which, though they had but from 1000 to 2000 inhabitants in 1801, were nevertheless classed as "progressive." On the other hand, all the towns treated as "unprogressive" in 1801–1891 have shown poor rates of increase, as have also many "progressive" towns which numbered from 2000 to 4000 inhabitants in 1801.

THE *Journal de Physique* for January contains a short abstract of a paper by P. van der Vlieth on an apparatus for demonstrating the linear conduction of heat, the original paper being in the *Journal* of the Russian Physico-Chemical Society. A bar of iron of section 5×5 cm. is heated by a jet of steam at one end and cooled at the other by a stream of water. Its lateral surface is covered by a thick coating of felt and cork, and a series of six thermometers is placed in holes made in the bar. After about half an hour the distribution of heat is stationary, and the temperature gradient as shown by the thermometers is almost exactly a straight line.

PROF. P. ZEEMAN, writing in the *Archives néerlandaises*, describes an experiment relating to the change of phase which occurs when a pencil of light-waves passes through a focus or focal line, a phenomenon to which Gouy has given the name of anomalous propagation. The experiments were made with a plano-convex lens of Iceland spar placed between two crossed nicols, and consisted in observing the rings produced by interference of the ordinary and extraordinary rays. When the centre of the system is black or white between the two foci, M. Gouy's theorem shows that it must be white or black respectively beyond the foci. Prof. Zeeman also gives an independent mathematical investigation of the phenomenon based on treating the focus as a doublet.

A HISTORICAL and critical essay of considerable length, on the definitions of the Bernouillan function, has been published by Prof. H. Renfer, of St. Gallen, in the *Mittheilungen der*

naturforschenden Gesellschaft in Bern for 1900, of which Messrs. Williams and Norgate have forwarded a copy. The essay consists in a detailed examination of the treatments of Raabe, Schlömilch, Schäfli and J. W. L. Glaisher, and the author gives tables as well as graphs of the functions according to the four corresponding alternative definitions. As a result of the examination, Prof. Renfer decides that L. Schäfli's definition is to be preferred on account of (1) its wider limits of convergency, (2) the greater simplicity of form of the formulæ, (3) this form being the most general, and (4) the theory assuming a more compact form on account of the assumed fundamental relation between Bernouillan numbers and functions and the applications of the principle of indeterminate coefficients.

THE "Antonio Alzate" Society, of Mexico, has published the proceedings and reports of the first national meteorological congress held in that country, and convened under its auspices on November 1, 2 and 3, 1900. The congress was attended by thirty-one members, chiefly directors of observatories and delegates of the various States. Many questions of general interest, mostly tending to ensure uniformity in the methods employed, were discussed. Some of the reports handed in contain valuable discussions of the rainfall and climate of various localities in Mexico. A paper was also read by a lady member, Señorita R. Sánchez Suárez, on the barometer and the prediction of weather.

ON comparing the principal meteorological results of the year 1901 at Greenwich Observatory with those of the last sixty years, the mean temperature (49°·6) is found to be −0°·5 below the average; there was nothing remarkable in the absolute extremes of temperature, the maximum being 87°·9, on July 19, and the minimum, 20°·4, on February 14, giving an absolute range of 67°·5. The rainfall, as in several previous years, was below the mean, the amount of deficiency being 3·28 inches; there was a slight excess in March and April, and a large excess, 1·74 inch, in December, while deficiencies exceeding an inch occurred in January and November. The amount of bright sunshine exceeded the mean of the last twenty years by 290 hours; the largest amount was recorded in May (237 hours), and the least in February (27 hours).

IN an illustrated article on the boats of the Samoans, in *Globus* (vol. lxxx. 1901, p. 167), Prof. Thilenius points out that the remarkable migrations of the Polynesians were accomplished by means of the *alia* or double canoe. Some of these canoes can accommodate more than a hundred persons, and the type extends from Hawaii to New Zealand and from Viti to the Marquesas.

SO little is known about the brains of primitive peoples that we welcome with especial pleasure the careful study of the brain of an Eskimo man by Dr. A. Hrdlicka in the *American Anthropologist* (1901, p. 454). As a whole this brain is heavier and larger than the average brain of white men of similar stature, and the cerebrum rather exceeds that of an average white male in the number, extent and depth of the sulci and in the complexity of the gyrations.

G. PAUL-BONCOUR gives, in the *Bulletins de la Société d'Anthropologie de Paris* (v. sér. t. ii. 1901), the first of a series of studies on the skeletal modifications consequent on infantile hemiplegia. This detailed study deals with the femur, and the author gives a careful comparison of the healthy femur with that of the paralytic side of a number of subjects. The last of his conclusions is the only one that will interest the general reader; he says: "From the anthropological point of view it has been possible pathologically to establish reasonable and clear transitions between human femurs and the femurs of anthropoids."

"NOTES on the Ancient Model of a Boat and Warrior Crew found at Roos in Holderness," by Mr. Thomas Sheppard, is the title of the fourth of the *Hull Museum Publications*. This little brochure, which is illustrated by four figures and two plates, is sold to the public for one penny. The curator is to be congratulated on producing such an interesting little essay on a remarkable model, probably of Scandinavian manufacture, of a wooden boat, the prow of which is carved to represent a snake's head with small quartz eyes. On the boat are four nude male figures, each of which was originally provided with a club and a large and a small round shield; their eyes also were pieces of quartz. The figures are from 14 to 16 inches in height.

ARCHÆOLOGISTS have long been accustomed to accept the statement that there is a hiatus between the Palæolithic and Neolithic stages of culture; but of late years more detailed research has indicated evidence of a transitional culture in the south of France and elsewhere. Quite recently A. Laville has investigated sections of certain hills in the valley of the Seine, and he claims (*Bulletins et Mémoirs de la Soc. d'Anthropologie de Paris*, v. sér. t. ii. 1901, p. 206) to have discovered two layers which he terms "Infra-Neolithic." These correspond, according to him, with the layers B and C of the famous cave of Mas d'Azil, so admirably worked out by E. Piette, and to which the attention of readers of NATURE has been called. There is a second paper (p. 285) by the same author, in which he figures a specimen from a basement zone which he claims to be an implement of the Chellian type, but in which M. Verneau cannot discover any evidence of human workmanship.

FIRE is regarded by the Hopi Indians of Arizona as a living being, its cultus consisting primarily of rites for germination, and, secondarily, for rain making. The lesser new-fire ceremony, which is described by Dr. J. Walter Fewkes in the *American Anthropologist* (n.s., vol. iii. p. 438), has these two purposes. The special gods worshipped are the germ-father and the germ-mother; the former is the fire god and is communicated with by means of prayer-sticks placed in his shrine, or prayer-fires kindled in the vicinity of the same. The germ-mother, called in this ceremony by the name of her animal personation (spider woman), is communicated with by invocations consisting of archaic monosyllables shouted by the chief. The personators of the ancient priests wear face-shields or masks; the latter have magic power, and their presence on the altar is a symbolic or mute suggestion of the elaborate ceremony of the ancients.

WE have received specimens of wall maps of Africa and South America, compiled and drawn by Prof. Guido Cora and published by Messrs. Paravia and Co. These maps, which are the first of a new series, are on a scale of 1 : 8,000,000, and show the physical features correctly and clearly. Ethnographic and political maps, on a scale of 1 : 25,000,000, are shown as insets; and profiles on a vertical scale of 1 : 200,000, along the equator in the case of Africa, and the parallel of 19° S. in the case of South America, form useful additions.

THE December number of *Petermann's Mittheilungen* contains several articles of more than average general interest. Prof. Gerland writes on Italian earthquakes and Baratta's seismic map of Italy, Prof. Wieser on the oldest map bearing the name "America," and Dr. Ernest Stromer on Lake Tanganyika. Dr. Vogelgesang concludes the first part of an account of journeys in northern and central China. Dr. Henkel contributes a note on the distance limit of visibility of land of a certain elevation from the sea, and adds a map of Greece showing the limits for a number of mountain summits.

THE marine submergence of the Gobi during the Secondary period becomes more and more doubtful, in proportion as we

learn more about this region. The Russian geologist, Bogdanovich, notwithstanding a most careful search, has found during his three years' journey no traces of this submergence. Stoliczka's fossils are apparently similar to those found by the Russian explorers further north, which have proved to be Devonian. Obrucheff's fossils from the eastern Gobi belong to freshwater lacustrine deposits. And now we learn from Prof. Tschernyscheff (*Verhandlungen* of the St. Petersburg Mineralogical Society, xxxviii. 2) that the fossils brought in by D. A. Klements from the Dzungarian Gobi, from a spot, Nyursu, situated to the east of Pyevtsoff's route from Kobdo to Guchen, belong to the Permo-Carboniferous strata, which are known in the Urals as the Artinsk horizon. They contain Bryozoa (Polypora and Fenestella), the polypes *Stenopora columnaris*, var. *Ramosa multigemmata*, and the molluscs *Productus purdoni*, *P. asperulus*, *P. mexicanus*, *Chonetes transitionis*, *Rhynchopora nikitini*, *Reticularia lineata*, *Martinia semiglobosa*, *Spirifer cameratus* and *Bairdia curta*. The character of this fauna is also similar to the fauna which was found by Loczy in the provinces of Se-chuen and Yunnan.

IN the *Notes* of the Leyden Museum (vol. iv. p. 191) Dr. F. A. Jentink describes a skin of the rare Bornean bay cat (*Felis badia*), which he believes to be the fourth known specimen. In the same issue Dr. O. Finsch continues his catalogue of the ornithological collection at Leyden.

IN the *Sitzungsberichte* of the Vienna Academy (1901, No. 25), Prof. R. von Wettstein draws attention to the important zoological and botanical collections obtained by the recent expedition to south Brazil. He directs attention to the marked changes caused in the vegetation of the country by plants introduced, either accidentally or on purpose, during the last century.

IN the January number of the *Entomologist*, Mr. F. B. Dodd describes a peculiar instrument by means of which the silk-producing moths of the Australian genus Antheræa cut their way out of their hard cocoons. The instrument "is a short hard black and curved thorn, situated in the thick joints at the base of the fore-wings, one on each side; in a rubbed specimen the thorn is easily discernible, but in a good one it is concealed amongst the dense scales. . . . It would be interesting to know whether anyone can state whence the liquid issues which the moth discharges to soften the cocoon where he cuts through; it must issue from near the thorn, for, as a rule, the scales left at the base of the wing and alongside the thorax are wet and matted when the moth emerges."

TO the issue of the *Journal* of the Straits Branch of the Royal Asiatic Society for July last Captain S. S. Flower contributes an interesting series of notes on the millipedes, centipedes, scorpions and allied creatures of the Malay Peninsula and Siam. The author sets an excellent example to other naturalists in the way he grappled with an unknown subject. "When I arrived in the Straits Settlements," he writes, "in March 1895, I knew practically nothing of these animals, how they were classified, how to distinguish between them, or which were poisonous and which harmless, and in no book or paper could I find the information I wanted, so I set to work to collect and examine specimens, and compare them with such literature as was available." The result of this energy and perseverance is the long and well-annotated list before us.

MR. G. ARCHDALL REID contributes to the current number of the *Monthly Review* an instructive and clearly written account of "the rationale of vaccination." After an explanation of the causes of zymotic diseases, it is explained that there are two kinds of immunity from them—the inborn and the acquired. The former prevents infection, the latter prevents reinfection, and both kinds have arisen in the human race through a process of natural selection. When, as in the case of measles, immunity can be acquired by the individual, natural selection has evolved a power of recovering from infection. Thus, Englishmen, who have long been afflicted by measles, are as certainly infected, but recover much more easily than Polynesians, to whom the disease has only lately been introduced. After passing in review the theories which have previously been held to explain acquired immunity, Mr. Reid shows that it is due to an habituation to the toxins of that disease. This result is brought about by the digestion in the blood of the toxins, so that there are present in the animal's blood toxins in all stages of attenuation, from those newly produced by the microbes, and extremely virulent, to those produced in the beginning of the disease and now in a state of great enfeeblement. Up that graduated scale the cells of the animal react till complete immunity is attained. The serum treatment artificially supplies digestive substances and, what is even more important, a scale of attenuated toxins. Applying these principles to the case of small-pox, the necessity for periodical vaccination is established. It is pointed out that, since small-pox is an air-borne disease, isolation, by itself, has no greater power of controlling small-pox than the historic old lady with a broom had of sweeping back the Atlantic. In the absence of vaccination isolation would be worse than useless.

A NEW edition (the third) of "Practical Radiography," by Messrs. A. W. Isenthal and H. Snowden Ward, has been published by Messrs. Dawbarn and Ward. Many additions have been made to the original volume, and the position and possibilities of radiography at the present time are fairly represented. The book is a useful guide to many aspects of work with Röntgen rays, and in it the authors judiciously combine practical hints with descriptions of theoretical interest.

THE German weekly scientific periodical *Die Natur* has just commenced a new half century in its existence, the first number having appeared on January 3, 1852. The journal was founded by the late Dr. Otto Ule and Dr. Karl Müller, and has maintained a high position among scientific periodicals from the commencement. The present editor is Herr H. Behrens. The cordial relationship which has existed between the French and German periodical representatives of Nature and ourselves is one instance among many of the cosmopolitan character of scientific interests. We congratulate *Die Natur* upon its jubilee and trust that its work and influence in the future will be even more extensive than in the past.

MR. C. E. BENHAM has prepared a series of seven stereoscopic diagrams, published by Messrs. Newton and Co., illustrating the polarisation of light. These diagrams show, in stereoscopic relief, the various directions of vibration in a light-wave, the passage of a ray through a doubly refracting crystal, the action of Nicol's prisms, and polarisation by reflection. The figures are drawn in white lines on a black ground, and they should be very useful for demonstration purposes. The only fault we have to find with them is that the right-hand and left-hand blocks in several cases are of unequal size, and present in the stereoscope the appearance of pieces of black paper which have been turned up at one side and slant towards the observer instead of looking like screens placed behind the diagrams. This is particularly confusing when there are two diagrams on the same slide, and the black patches appear tilted in opposite directions.

THE additions to the Zoological Society's Gardens during the past week include a Patas Monkey (*Cercopithecus patas*), a Ground Hornbill (*Bucorvus abyssinicus*) from Kontagora Nigeria, presented by Captain E. H. Lewis; a Common For

(*Canis vulgaris*) from Savoy, presented by M. Leon Montaigne; a White-crested Tiger-Bittern (*Tigriosoma leucolophum*) from West Africa, presented by Mrs. F. M. Hand; nine Pheasant-tailed Jacanas (*Hydrophasianus chirurgus*) from India, presented by Mr. Frank Finn; a Horned Capuchin (*Cebus apella*) from South America, a Feline Douroucouli (*Nyctipithecus vociferans*) from South Brazil, four Crowned Partridges (*Rollulus cristatus*) from Malacca, deposited; a White-tailed Gnu (*Connochaetus gnu*, ♀), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

DIAMETER OF JUPITER.—In continuation of his series of determinations of planetary diameters with the 26-inch refractor at Washington, Prof. T. J. J. See gives the reduced measures of Jupiter in *Astronomische Nachrichten*, Bd. 157, No. 3757. The observations were made during daylight, using the colour screen over the eye-piece for eliminating the secondary fringes, &c. For the final evaluation of the diameter sixty-eight measures are employed, extending over the period 1901 September 6-October 1; from these he gives:—

Equatorial diameter of Jupiter = 37″·646 ± 0″·014
= 141,950 ± 53 km.

Prof. See thinks this very closely approximates to the absolute value of the diameter, and by comparing it with the value obtained at night, when the planet is seen as a very brilliant object on a dark background, he obtains a measure of the irradiation. The night value is 38″·40, which gives for the irradiation:—

I = 0″·755 ± 0″·040
= 2847 ± 150 km.

As these values are so different, the suggestion is made of the advisability of adopting two sets of planetary diameters, one representing the apparent size of the planet as seen at night, to be used in physical observations and ephemerides, work on satellites, &c., the other representing the true dimensions of the spheroid independent of its illumination by the sun, to be employed in the theory of the planet's figure, constitution, &c.

The resulting absolute dimensions of the Jovian spheroid referred to the distance 5·20 are:—

Equatorial diameter	= 37″·646 = 141,950 km.
Polar diameter ...	= 35·222 = 132,810 km.
Oblateness	= 1:15·53.
Assumed mass ...	= 1:1047·35 (Newcomb).
Density	= 1·35 (water = 1).

"THE HEAVENS AT A GLANCE," 1902.—This handy little publication for the present year is issued in a slightly modified form. The author has repeatedly had inquiries respecting the inclusion of one or more star maps, and the present edition is furnished with two, one showing the northern stars, the other the southern objects visible from Great Britain. Another additional feature is the small map of the moon, showing the principal lunar formations.

All the more important phenomena are given for the year, and a series of summaries of the particulars relating to variable and coloured stars, nebulæ, &c.

VARIABLE STAR CATALOGUE.—In the *Astronomical Journal*, vol. xxii. No. 514, the committee appointed by the Council of the Astronomische Gesellschaft publish a further catalogue giving the elements of stars which have been certainly recognised as variable since the publication of Chandler's third catalogue (*Astronomical Journal*, vol. xvi., pp. 145–172). The present list gives the definitive designations for 191 variables, and also for the three Novæ in Perseus, Sagittarius and Aquila.

CATALOGUE OF 100 NEW DOUBLE STARS.—*Bulletin* No. 12 from the Lick Observatory comprises the fourth catalogue of new double stars having distances under 5″, discovered by W. J. Hussey with the 36-inch telescope at Mount Hamilton. (The first three catalogues appeared in the *Astronomical Journal*, Nos. 480, 485, 494.)

The search is being conducted in a systematic manner, and it is hoped that the work when more advanced will afford data for an investigation into the distribution of close double stars in various parts of the sky, and of their numbers with respect to magnitude.

THE TEACHING OF MATHEMATICS IN PUBLIC SCHOOLS.

THE following letter has been sent to the Committee appointed by the British Association to report upon the teaching of elementary mathematics.

GENTLEMEN,—At the invitation of one of your own body, we venture to address to you some remarks on the problems with which you are dealing, from the point of view of teachers in public schools.

As regards geometry, we are of opinion that the most practical direction for reform is towards a wide extension of accurate drawing and measuring in the geometry lesson. This work is found to be easy and to interest boys; while many teachers believe that it leads to a logical habit of mind more gently and naturally than does the sudden introduction of a rigid deductive system.

It is clear that room must be found for this work by some unloading elsewhere. It may be felt convenient to retain Euclid; but perhaps the amount to be memorised might be curtailed by omitting all propositions except such as may serve for landmarks. We can well dispense with many propositions in the first book. The second book, or whatever part of it we may think essential, should be postponed till it is needed for III, 35. The third book is easy and interesting; but Euclid proves several propositions whose truth is obvious to all but the most stupid and the most intellectual. These propositions should be passed over. The fourth book is a collection of pleasant problems for geometrical drawing; and, in many cases, the proofs are tedious and uninstructive. No one teaches Book V. A serious question to be settled is—how are we to introduce proportion? Euclid's treatment is perhaps perfect. But it is clear that a simple arithmetical or algebraical explanation covers everything but the case of incommensurables. Now this case of incommensurables, though in truth the general case, is tacitly passed over in every other field of elementary work. Much of the theory of similar figures is clear to intuition. The subject provides a multitude of easy exercises in arithmetic and geometrical drawing; we run the risk of making it difficult of access by guarding the approaches with this formidable theory of proportion. We wish to suggest that Euclid's theory of proportion is properly part of higher mathematics, and that it shall not in future form part of a course of elementary geometry. To sum up our position with regard to the teaching of geometry, we are of opinion—

(1) That the subject should be made arithmetical and practical by the constant use of instruments for drawing and measuring.

(2) That a substantial course of such experimental work should precede any attack upon Euclid's text.

(3) That a considerable number of Euclid's propositions should be omitted; and in particular

(4) That the second book ought to be treated slightly, and postponed till III, 35, is reached.

(5) That Euclid's treatment of proportion is unsuitable for elementary work.

Arithmetic might well be simplified by the abolition of a good many rules which are given in text-books. Elaborate exercises in vulgar fractions are dull and of doubtful utility; the same amount of time given to the use of decimals would be better spent. The contracted methods of multiplying and dividing with decimals are probably taught in most schools; when these rules are understood, there is little left to do but to apply them. Four-figure logarithms should be explained and used as soon as possible; a surprising amount of practice is needed before the pupil uses tables with confidence.

It is generally admitted that we have a duty to perform towards the metric system; this is best discharged by providing all boys with a centimetre scale and giving them exercise in verifying geometrical propositions by measurement. Perhaps we may look forward to a time when an elementary mathematical course will include at least a term's work of such easy experiments in weighing and measuring as are now carried on in many schools under the name of physics.

Probably it is right to teach square root as an arithmetical rule. It is unsatisfactory to deal with surds unless they can be evaluated, and the process of working out a square root to five places provides a telling introduction to a discourse on incommensurables; furthermore, it is very convenient to be able to assume a knowledge of square root in teaching graphs. The